

The World Around Us:

“Why Do Mosquitoes Love Me So Much?”

Presentation by Jay Kiser

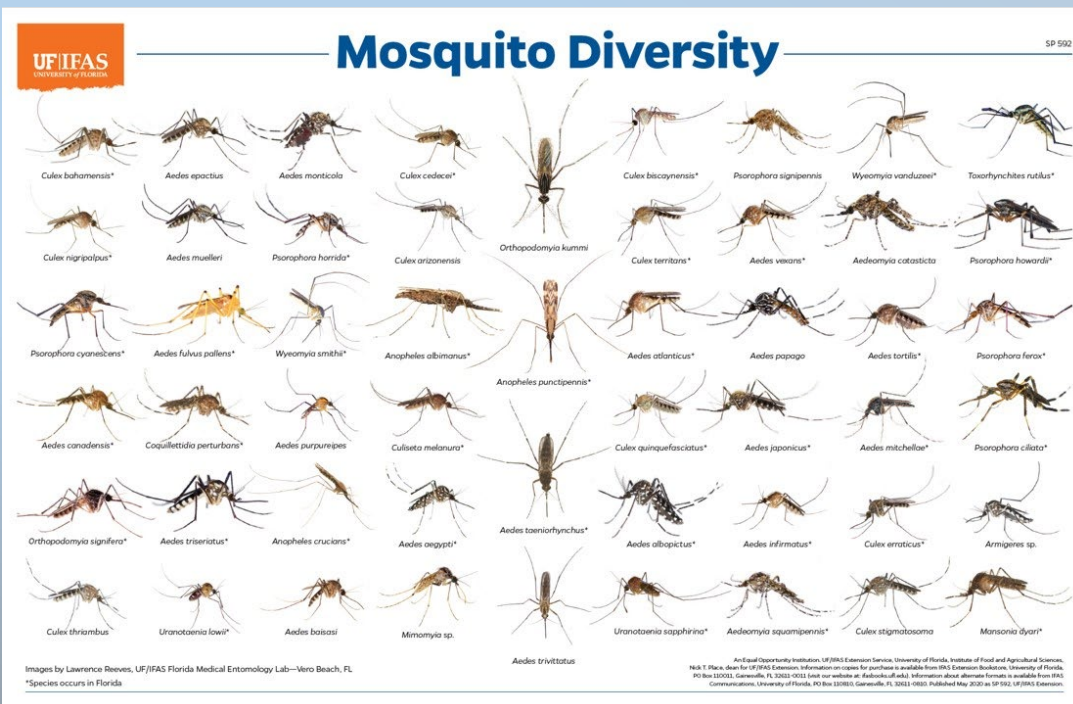
“Why do mosquitoes love me so much?”

- My general answer:
 - We all have slightly different smells to us and different mosquito species/individuals have their own preferences.
- If this answer does not satisfy them, this presentation may give you some interesting examples as to why... but none of these are a silver bullet



Mosquito Diversity

- Every species has their own behaviors and attractions
- Most of the examples I bring up here, are from species that feed mostly on humans or are nuisances to humans
 - *Aedes aegypti*
 - *Aedes albopictus*
 - *Anopheles gambiae*



Temperature/Body heat

- Mosquitoes are more attracted to higher body temperatures
- Differences in metabolic rate or metabolism
- Differences in mass
 - Adults vs children
 - Pregnant vs non-pregnant
 - Larger vs smaller adults
 - Goncalves et al. 2017
 - Lindsay et al. 2000



Blood Type

- Human Blood types:
 - A, B, AB, or O

- *Aedes albopictus*: O

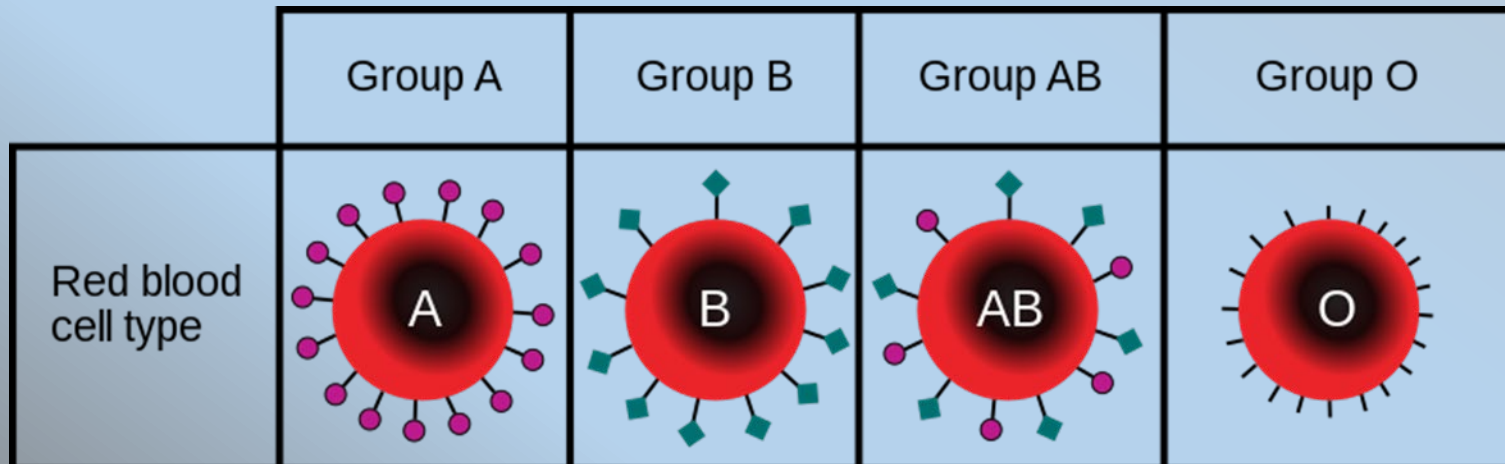
- (Shirai et al 2004)

- *Aedes aegypti*: O

- (Prasadini et al 2019)

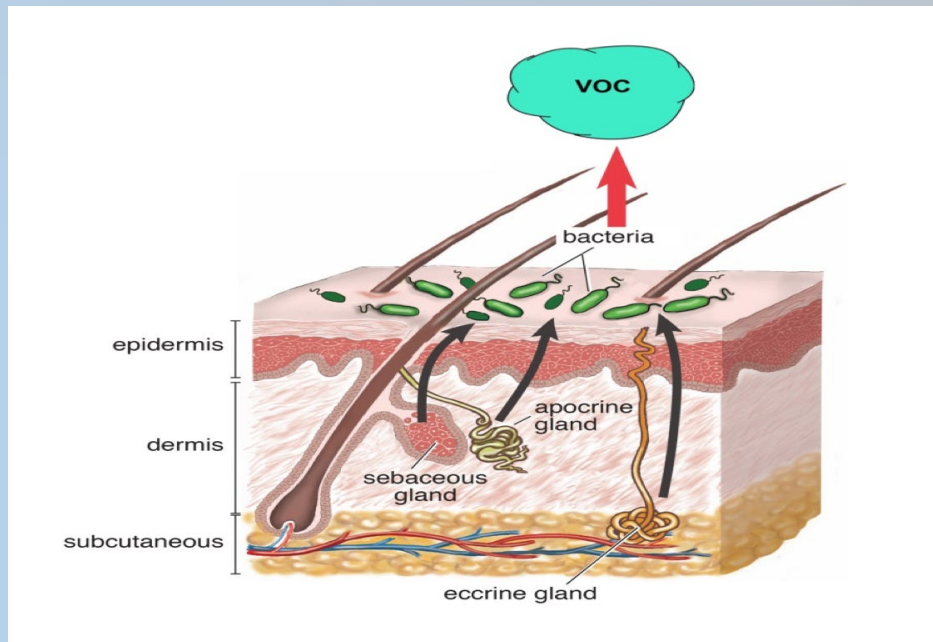
- *Anopheles gambiae*: AB

- (Anjomruz et al 2014)



Odors and Chemicals

- Volatile organic compounds (VOCs)
 - Humans produce hundreds of these that we excrete from our skin
 - Mosquitoes can hone in on these
 - Martinez et al. 2021



Diet

- Consumption of alcohol
 - (Shirai et al, 2002)
 - *Aedes albopictus* significantly more attracted to individuals that have consumed alcohol
 - Peak of ethanol in sweat between 23-33 min after drinking. This time is when *Ae. albopictus* are most attracted to those individuals



Diet

- Consumption of bananas
 - (Paskewitz et al, 2018)
- 1-3 hours after eating
 - Increased mosquito bites up to 161%
 - *Anopheles stephensi*

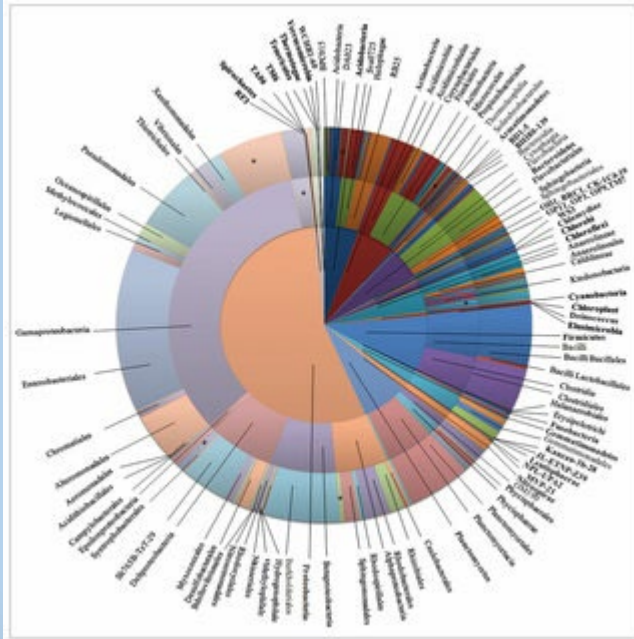


Bacteria: skin microbiome

- Lots of bacteria found on your skin
- Eating/metabolizing our dead skin cells and skin secretions/sweat and making their own VOCs
- *Anopheles gambiae* is much more attracted to human sweat that has been metabolized by bacteria than fresh human sweat
 - Braks and Takken 1999



Bacteria: skin microbiome



- Amount of bacteria and diversity can play a role
- Mosquitoes were found to be more attracted to humans that have a higher abundance of bacteria but at a lower diversity.

• Verhulst 2011



- Diet and age can change your microbiome over time

Bacteria: mouth and gut microbiome

- Lots of VOCs coming out of our mouths when we breath



VOCs Can Also Repel

- Many human VOCs act as a repellent to some mosquitoes
- *Aedes aegypti* are less attracted to people that produce more volatiles like octanal, decanal, and nonanal
 - Logan et al 2008
- The better question may be, “Why do mosquitoes dislike that guy, but not me?”



Thank you

No Time for Questions

Literature Cited

- Anjomruz M., Oshaghi M. A., Sedaghat M. M., Pourfatollah A. A., Raeisi A., Vatandoost H., Mohtarami F., Yeryan M., Bakhshi H., Nikpoor F. (2014) ABO blood groups of residents and the ABO host choice of malaria vectors in southern Iran. *Experimental Parasitology* 136: 63-67.
- Braks MAH, Takken W. 1999 Incubated human sweat but not fresh sweat attracts the malaria mosquito *Anopheles gambiae sensu stricto*. *J. Chem. Ecol.* 25, 302.
- Goncalves BP et al. 2017 Examining the human infectious reservoir for *Plasmodium falciparum* malaria in areas of differing transmission intensity. *Nat. Commun.* 8, 1133.
- Lindsay S, Ansell J, Selman C, Cox V, Hamilton K, Walraven G. 2000 Effect of pregnancy on exposure to malaria mosquitoes. *Lancet* 355, 1972.
- Logan JG, Birkett MA, Clark SJ, Powers S, Seal NJ, Wadhams LJ, Mordue (Luntz) AJ, Pickett JA. 2008 Identification of human-derived volatile chemicals that interfere with attraction of *Aedes aegypti* mosquitoes. *J. Chem. Ecol.* 34, 308–322.
- Martinez J, Showering A, Oke C, Jones RT, Logan JG. 2021. Differential attraction in mosquito–human interactions and implications for disease control. *Phil. Trans. R. Soc. B* 376: 20190811
- Paskewitz S, Irwin P, Konwinski N, Larson S. 2018 Impact of consumption of bananas on attraction of *Anopheles stephensi* to humans. *Insects* 9, 129.
- Prasadini M., D. Dayananda, S. Fernando, I. Harischandra, N. De Silva. 2019. Blood Feeding Preference of Female *Aedes aegypti* Mosquitoes for Human Blood Group Types and Its Impact on Their Fecundity: Implications for Vector Control. *American Journal of Entomology.* 3 (2): 43-48.
- Shirai Y., Funada H., Takizawa H., Seki T., Morohashi M., Kamimura K. (2004) Landing preference of *Aedes albopictus* (Diptera: Culicidae) on human skin among ABO blood groups, secretors or nonsecretors, and ABH antigens. *Journal of Medical Entomology* 41: 796-799.
- SHIRAI Y, TAKAO TSUDA, SHINYA KITAGAWA, KEN NAITOH, TAISUKE SEKI, KIYOSHI KAMIMURAI eNN MASA AKI MOROHASHI. 2002. ALCOHOL INGESTION STIMULATES MOSQUITO ATTRACTION. *Journal of American Mosquito Control Association.* 18(2):91-96.
- Si J, Lee S, Park JM, Sung J, Ko GP. 2015 Genetic associations and shared environmental effects on the skin microbiome of Korean twins. *BMC Genom.* 16, 922.
- Verhulst NO, Andriessen R, Groenhagen U, Kiss GB, Schulz S, Takken W, Van Loon JJA, Schraa G, Smallegange RC. 2010 Differential attraction of malaria mosquitoes to volatile blends produced by human skin bacteria. *PLoS ONE* 5, e15829.
- Verhulst NO et al. 2011 Composition of human skin microbiota affects attractiveness to malaria mosquitoes. *PLoS ONE* 6, e28991.